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(54) SPRING UNIT WITH DAMPER AND OPENING-CLOSING DEVICE

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(57) ABSTRACT

A spring unit with a damper includes a torsion coil spring having two ends portions and a wound portion between the two end portions, and a cylindrical spring member having a slit extending in a longitudinal direction and an outer diameter larger than an inner diameter of the wound portion. When the two end portions of the torsion coil spring rotates, the inner diameter is changed to generate a friction force between the torsion coil spring and the cylindrical spring member, thereby utilizing the friction force as a damping force.

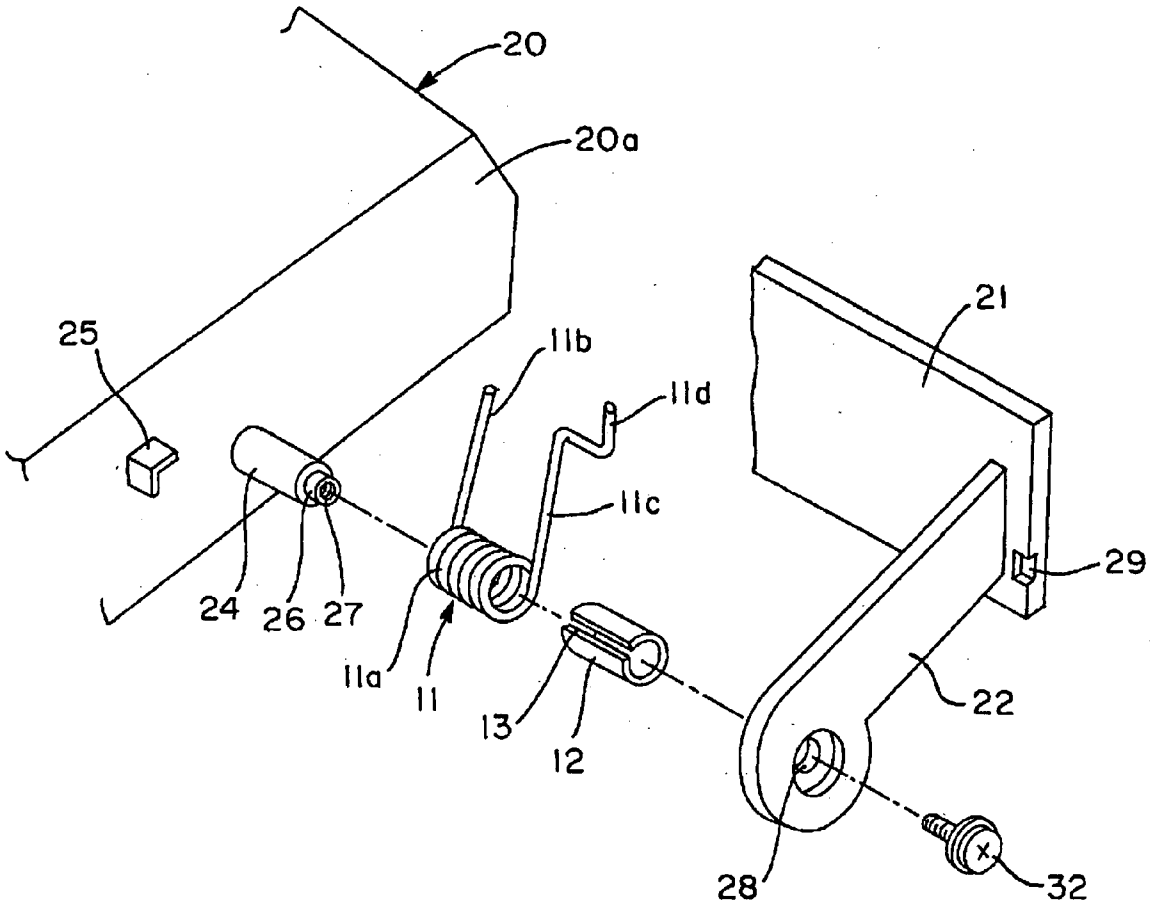


Fig. 1(a)

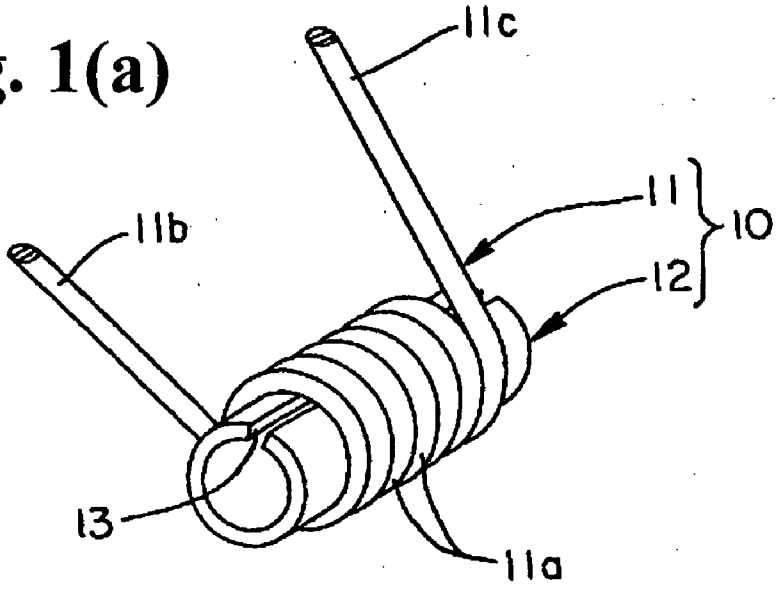
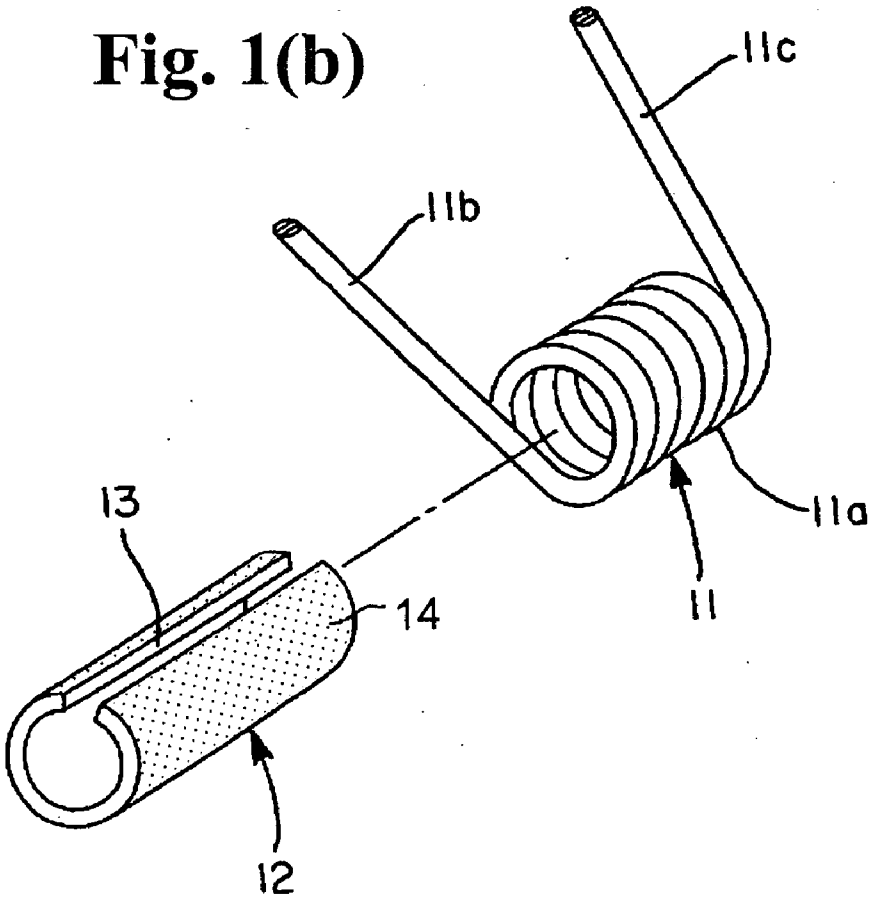


Fig. 1(b)



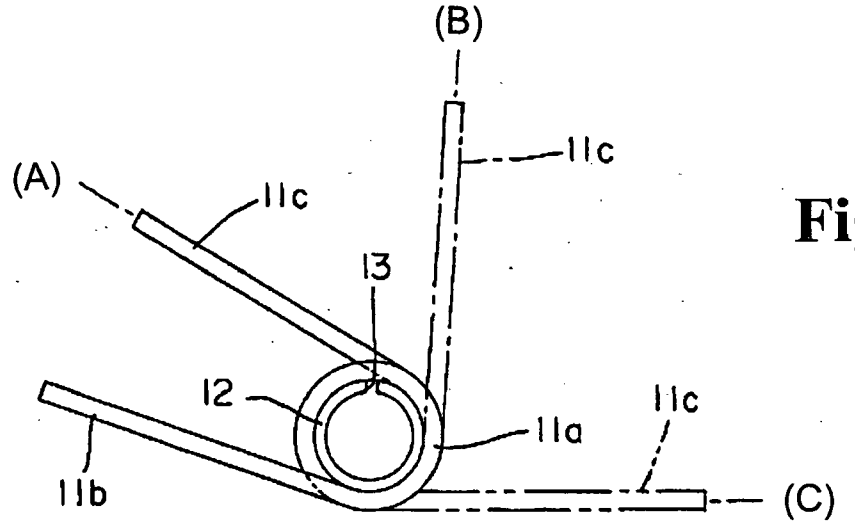


Fig. 2(a)

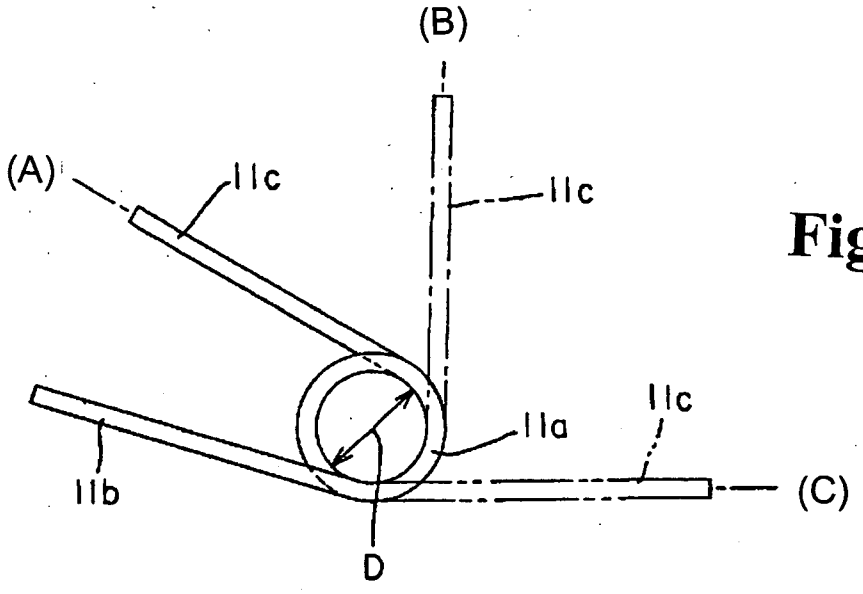


Fig. 2(b)

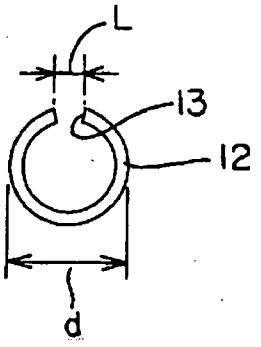


Fig. 2(c)

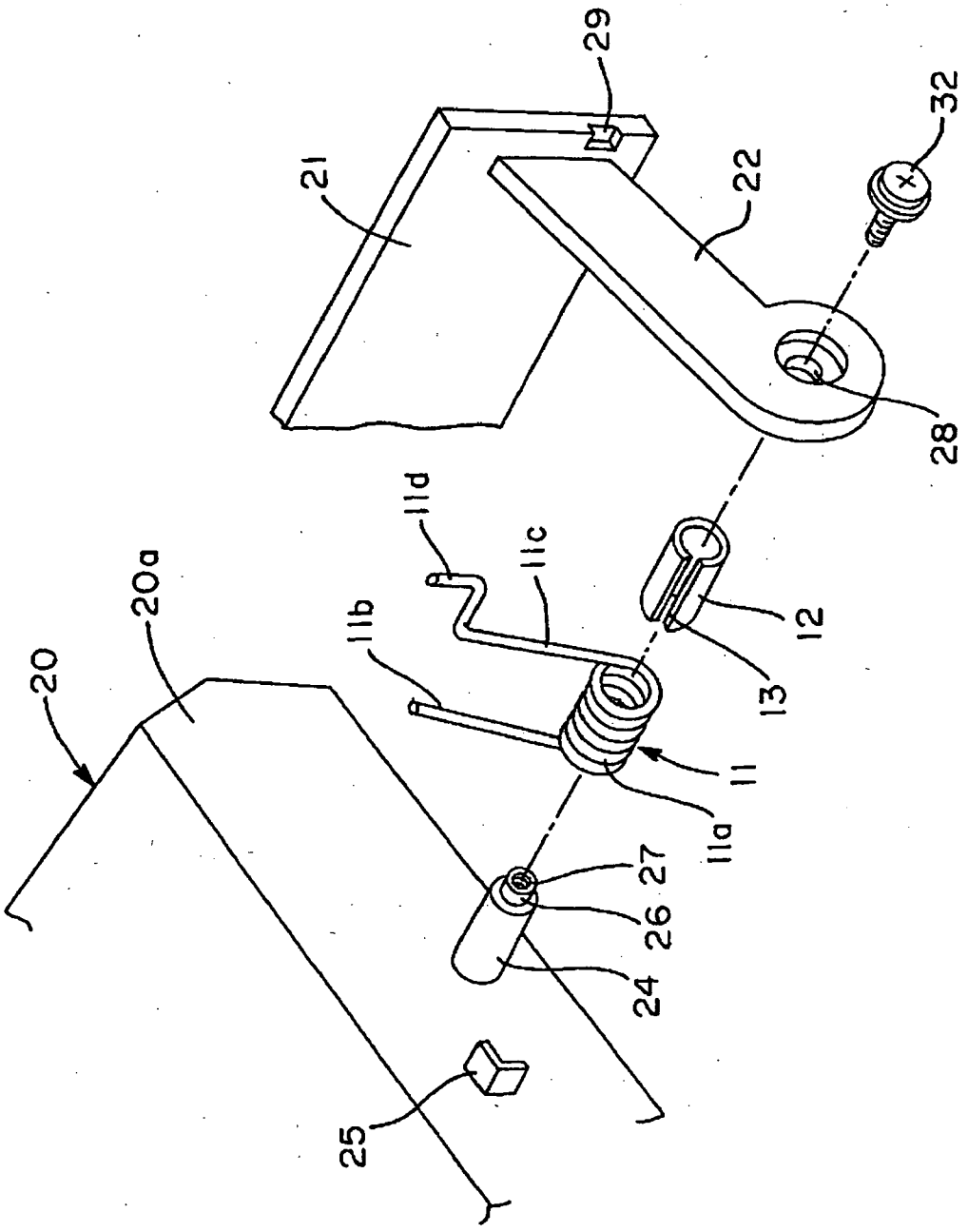


Fig. 3

Fig. 4(a)

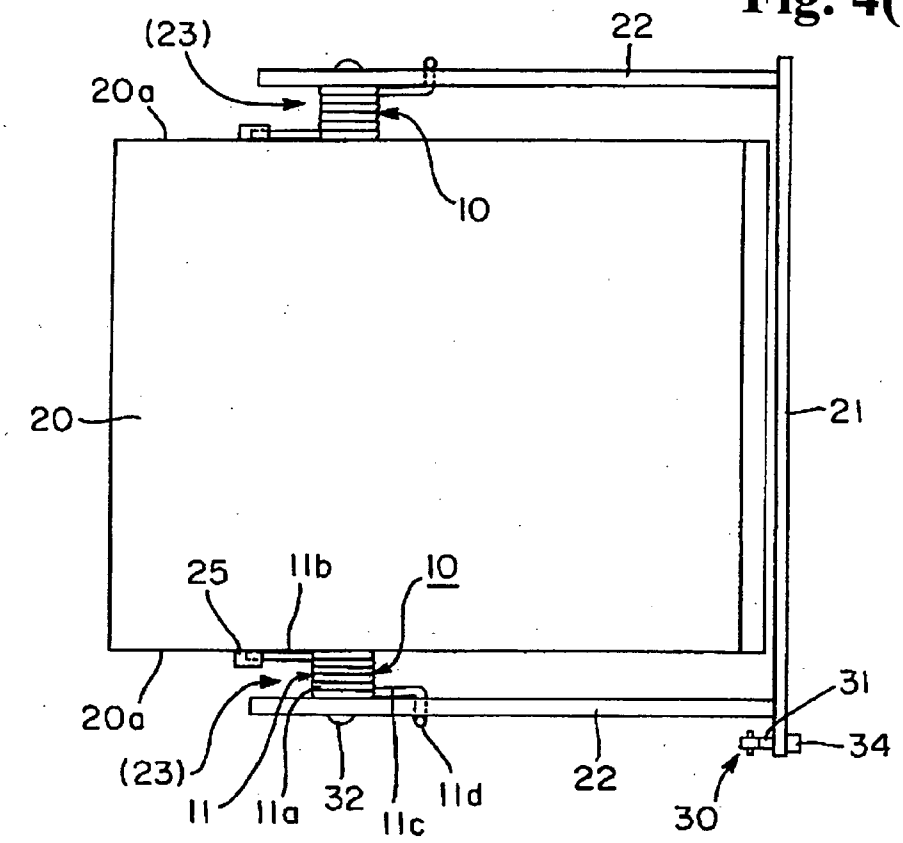
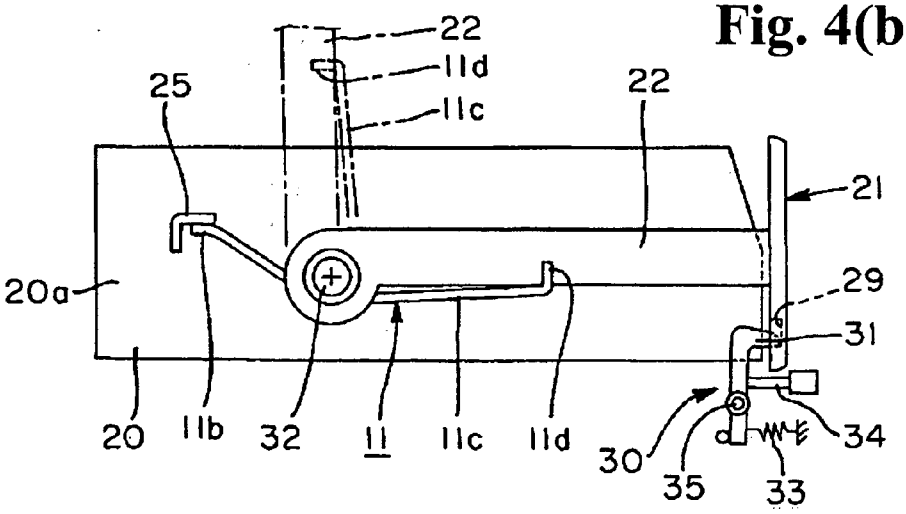

(23)
22
20a
10
20
21
25
11b
10
20a
31
34
(23)
11
11a
32
11c
11d
22
30

Fig. 4(b)


22
11d
11c
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11b
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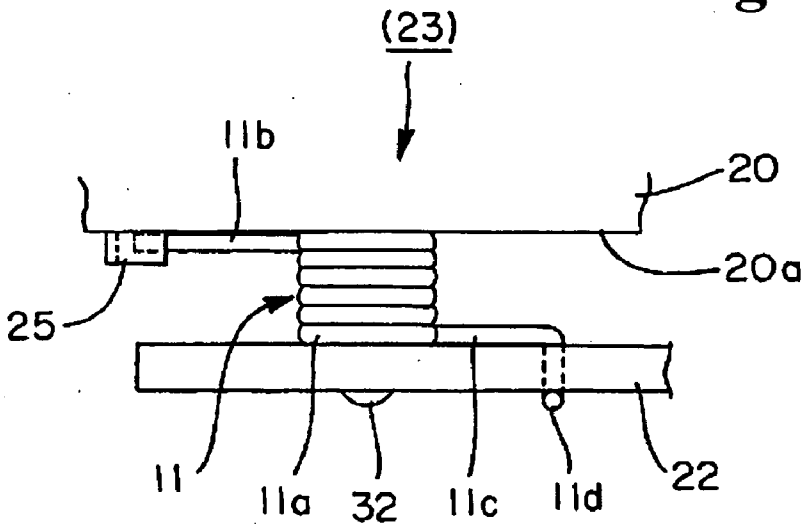
Fig. 5(a)


(23)
11b
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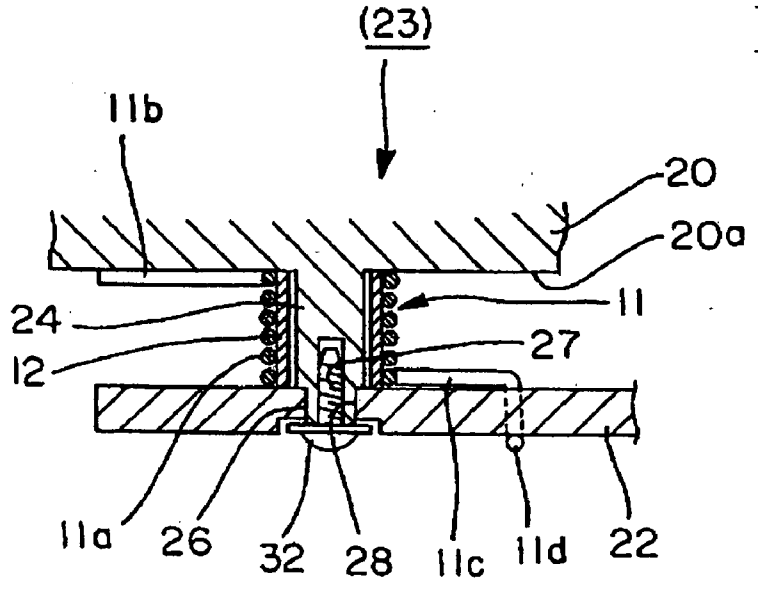
11c
11d
22

Fig. 5(b)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11a
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11c
11d
22

SPRING UNIT WITH DAMPER AND OPENING-CLOSING DEVICE

BACKGROUND OF THE INVENTION AND RELATED ART STATEMENT

[0001] The present invention relates to a spring unit with a damper, and an opening-closing device for switching a lid relative to a main body.

[0002] In an opening-closing device of a rotary lid, a spring urges an opening-closing body such as a rotary lid toward an opening position. When the rotary lid is released from a closed position, the rotary lid is switched toward the opening position with the spring. As the spring, a torsion spring is used to accumulate a maximum force at the closed position of the rotary lid in a case that the rotary lid is switched toward the opening position from the closed position with the spring.

[0003] Conventionally, an oil damper is provided for damping a rotational speed of an opening-closing body, so that the opening-closing body rotates smoothly. When it is difficult to provide an oil damper due to cost limitation, a cushion may be provided near a closed position of the opening-closing body, thereby preventing the opening-closing body from bouncing. Instead of the cushion, Patent Reference 1 has disclosed a structure, in which a rotational shaft is provided inside a torsion spring, and a friction member is disposed in a cut portion of the rotational shaft. In the structure, when an opening-closing body rotates, the torsion spring rotates together with the opening-closing body. Accordingly, an inner diameter of a wound portion of the torsion spring is reduced with the rotation of an end portion of the torsion spring, so that the wound portion presses the friction member against the rotational shaft, thereby utilizing a pressing force and a frictional force as a damping force.

[0004] Patent Reference 1: Japanese Patent Publication (Kokoku) No. 02-52753.

[0005] The opening-closing device disclosed in the storage device **1** has the structure in which the friction member is attached to a part of the rotational shaft. Accordingly, the friction member tends to wear easily, thereby making the damping force unstable in a relatively early stage and making it difficult to maintain the original damping force for long time.

[0006] In view of the problems described above, an object of the present invention is provide an opening-closing device with a simple structure, in which it is possible to maintain an original damping force for long time, and it is easy to obtain a desirable damping force.

[0007] Further objects and advantages of the invention will be apparent from the following description of the invention.

SUMMARY OF THE INVENTION

[0008] According to a first aspect of the present invention, a spring unit with a damper includes a torsion coil spring having two ends portions and a wound portion between the two end portions, and a cylindrical spring member with a C-shape cross section having a slit extending in a longitudinal direction and an outer diameter larger than an inner diameter of the wound portion. When the two end portions of the torsion coil spring rotates, the inner diameter is changed to generate a friction force between the torsion coil spring and the cylindrical spring member, thereby utilizing the friction force as a damping force.

[0009] According to a second aspect of the present invention, a spring unit with a damper may include an intermediate material such as oil disposed between the wound portion and the cylindrical spring member.

[0010] According to a third aspect of the present invention, an opening-closing device switches an opening-closing body relative to a main body. The opening-closing body is rotatably attached to the main body. The opening-closing device includes a spring unit formed of a torsion coil spring having two ends portions and a wound portion between the two end portions. One of the two end portions is fixed to the opening-closing body, and the other of the two end portions is fixed to the main body. The torsion coil spring switches the opening-closing body toward one of an open position and a closed position. The spring unit further includes a cylindrical spring member with a C-shape cross section having a slit extending in a longitudinal direction and an outer diameter larger than an inner diameter of the wound portion. When the two end portions of the torsion coil spring rotates, the inner diameter is changed to generate a friction force between the torsion coil spring and the cylindrical spring member, thereby utilizing the friction force as a damping force.

[0011] According to a fourth aspect of the present invention, in the opening-closing device, in a case that the spring unit urges the opening-closing body toward the open position from the closed position, it is preferred that the wound portion has an inner diameter at the open position larger than that in an original state of the torsion coil spring (before being attached to the opening-closing body). Further, it is preferred that the inner diameter increases when the opening-closing body rotates to the closed position from the open position.

[0012] In the present invention, when the torsion coil spring rotates in a direction that the wound portion is further wound with the one end, the inner diameter thereof is reduced and presses the cylindrical spring member to generate the friction force. At this time, the cylindrical spring member deforms such that the slit is narrowed, thereby absorbing the friction force to some extent. On the other hand, when the torsion coil spring rotates in an opposite direction that the wound portion is unwound with the one end, the friction force relative to the cylindrical spring member is reduced. At this time, the cylindrical spring member deforms such that the slit is expanded, thereby maintaining the friction force at an appropriate level. Accordingly, with the structure of the present invention, even if the wound portion or the cylindrical spring member wears, it is possible to finely adjust torque through restoration of the wound portion and the cylindrical spring member, thereby maintaining the damping force constant without a variance in the damping force due to the wear.

[0013] In the present invention, it is possible to obtain the following advantages. In the first aspect, the cylindrical spring member has the C-shape cross section and the outer diameter larger than the inner diameter of the wound portion. The cylindrical spring member is fitted into the wound

portion of the torsion coil spring. Accordingly, it is possible to adjust variance in the damping force due to the wear of the wound portion and the cylindrical spring member with the restoration force of the cylindrical spring member, thereby reducing the variance and obtaining a stable operation.

[0014] In the second aspect, the intermediate material such as oil is disposed between the wound portion and the cylindrical spring member, thereby stabilizing and adjusting the damping force.

[0015] In the third aspect, it is possible to make the opening-closing device simple and stably damp a rotational speed of the opening-closing body for long time. Further, it is possible to change the damping force according to the rotational direction of the opening-closing body. It is possible to form the spring unit with the torsion coil spring and the cylindrical spring member, thereby making the structure simple and reducing cost.

[0016] In the fourth aspect, in a case that the spring unit urges the opening-closing body toward the open position from the closed position, it is possible to increase the damping force or the friction force when the opening-closing body rotates to the open position from the closed position. And, it is possible to reduce the damping force or the friction force when the opening-closing body rotates to the closed position from the open position, thereby obtaining a proper switching operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIGS. **1**(*a*) and **1**(*b*) are views showing a spring unit with a damper according to an embodiment of the present invention, wherein **FIG. 1**(*a*) is a perspective view thereof, and **FIG. 1**(*b*) is an exploded view thereof;

[0018] FIGS. **2** (*a*) to **2**(*c*) are views showing the spring unit and components thereof, wherein **FIG. 2**(*a*) is a side view of the spring unit, **FIG. 2**(*b*) is a side view of a torsion coil spring, and **FIG. 2**(*c*) is a side view of a cylindrical spring member;

[0019] **FIG. 3** is an exploded perspective view of an electric device having an opening-closing device according to an embodiment of the present invention;

[0020] **FIG. 4**(*a*) is a plan view of the electric device, and **FIG. 4**(*b*) is a side view of the electric device; and

[0021] **FIG. 5**(*a*) is a plan view of an essential part of the electric device, and **FIG. 5**(*b*) is a side view of an essential part of the electric device.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0022] Hereunder, embodiments of the present invention will be explained with reference to the accompanying drawings. FIGS. **1**(*a*) and **1**(*b*) are views showing a spring unit with a damper according to an embodiment of the present invention, wherein **FIG. 1**(*a*) is a perspective view thereof, and **FIG. 1**(*b*) is an exploded view thereof. FIGS. **2**(*a*) to **2**(*c*) are views showing the spring unit and components thereof, wherein **FIG. 2**(*a*) is a side view of the spring unit, **FIG. 2**(*b*) is a side view of a torsion coil spring, and **FIG. 2**(*c*) is a side view of a cylindrical spring member. **FIG. 3** is an exploded view of an electric device having an opening-closing device according to an embodiment of the present invention. **FIG. 4**(*a*) is a plan view of the electric device, and **FIG. 4**(*b*) is a side view of the electric device. **FIG. 5**(*a*) is a plan view of an essential part of the electric device, and **FIG. 5**(*b*) is a side view of an essential part of the electric device. Detailed explanations in the order of the spring unit, and the opening-closing device will follow.

[0023] (Spring Unit)

[0024] In FIGS. **1**(*a*) and **1**(*b*) to **2**(*a*)-**2**(*c*), a spring unit **10** is formed of a torsion coil spring **11** made of a wire and a cylindrical spring member **12** made of steel or plastic. The torsion coil spring **11** has a wound portion **11***a* wound in a circle, and two end portions **11***b* and **11***c* of the wound portion **11***a* extending in a same direction. When the torsion coil spring **11** is rotated in a clockwise direction from a position indicated by a solid line in **FIG. 2**(*b*) in a state that the one end portion **11***b* is fixed, the wound portion **11***a* is unwound to expand an inner diameter D while accumulating a restoration force. When a force applied on the other end portion **11***c* is released, the torsion coil spring **11** is restored to an original shape with the restoration force, i.e., the wound portion **11***a* is wound to contract the inner diameter D.

[0025] In **FIG. 2**(*b*), when the torsion coil spring **11** rotates, the other end portion **11***c* moves relative to the one end portion **11***b* from an initial position (A) to an open position (B) to a closed position (C). When the other end portion **11***c* is located at the initial position (A), the inner diameter D is D**0**. When the other end portion **11***c* is located at the open position (B), the inner diameter D is D**1**. When the other end portion **11***c* is located at the closed position (C), the inner diameter D is D**2**. In this case, D**0** is smaller than D**1**, and D**1** is smaller than D**2**.

[0026] The cylindrical spring member **12** is made of plastic with die molding, or made of steel through rolling a metal plate into a cylindrical shape. The cylindrical spring member **12** has a gap (slit **13**) between two ends thereof, so that a cross section thereof becomes a C shape. The cylindrical spring member **12** has a length same or greater than that of the wound portion **11***a* in an axial direction thereof. The cylindrical spring member **12** has an outer diameter d (an outer diameter when the cylindrical spring member **12** is not disposed in the wound portion **11***a*) greater than the inner diameter D**2** of the wound portion **11***a* at the closed position (C). That is, the outer diameter d is greater than D**2**, D**2** is greater than D**1**, and D**1** is greater than D**0**.

[0027] A process of assembling the cylindrical spring member **12** into the torsion coil spring **11** will be explained next. The other end portion **11***b* of the torsion coil spring **11** is fixed, and the torsion coil spring **11** is rotated in a direction that the wound portion **11***a* is unwound beyond the closed position (C) until the inner diameter D of the wound portion **11***a* becomes greater than the outer diameter d of the cylindrical spring member **12**. In this state, the cylindrical spring member **12** is inserted into the torsion coil spring **11**, and then the force applied to the other end portion **11***c* for rotating the torsion coil spring **11** is released. Accordingly, the other end portion **11***c* rotates in an opposite direction, i.e., toward the original position (A), with the restoration force, and the inner diameter of the wound portion **11***a* is contracted, thereby pressing the wound portion **11***a* against an outer surface of the cylindrical spring member **12**.

[0028] The outer diameter d of the cylindrical spring member **12** is contracted with the pressing force. That is, the

outer diameter d becomes the same as the inner diameter D2 of the wound portion **11***a* **2** at the closed position (C), the same as the inner diameter D1 of the wound portion **11***a* at the open position (B), and the same as the inner diameter D**0** of the wound portion **11***a* at the original position (C). Accordingly, the cylindrical spring member **12** is assembled into the torsion coil spring **11** while always having a restoration force against the torsion coil spring **11**, thereby integrating the cylindrical spring member **12** and the torsion coil spring **11** as the spring unit **10**. The cylindrical spring member **12** and the torsion coil spring **11** operate as the spring unit **10** afterward.

[**0029**] As shown in **FIG. 2**(*a*), the one end portion **11***b* of the torsion coil spring **11** is fixed, and the other end portion **11***c* is rotated to the closed position (C) opposite to the open position (B) in the direction that the torsion coil spring **11** is wound. Then, from the state that the wound portion **11***a* is unwound, the other end portion **11***c* is rotated toward the open position (B), i.e., in the direction that the wound portion **11***a* is wound, with the restoration force. Accordingly, the wound portion **11***a* is wound and rotated relative to the cylindrical spring member **12** while contracting the inner diameter thereof with the rotation of the other end portion **11***c*.

[**0030**] When the wound portion **11***a* is rotated, an inner surface of the wound portion **11***a* is pressed against the outer surface of the cylindrical spring member **12**. The pressing force becomes a load against the rotation of the wound portion **11***a*, i.e., a damping force, thereby generating a damping effect. When the other end portion **11***c* is rotated from the open position (B) to the closed position (C), the wound portion **11***a* is unwound, thereby rotating the other end portion **11***c* toward the closed position (C) while reducing the frictional force between the wound portion **11***a* and the cylindrical spring member **12**.

[**0031**] In the spring unit **10**, the frictional force is always generated between the torsion coil spring **11** and the cylindrical spring member **12** with the restoration force. When the one end portion **11***b* of the torsion coil spring **11** is fixed, and the other end portion **11***c* is rotated in the one direction from the closed position (C) to the open position (B), the wound portion **11***a* is wound, thereby increasing the damping force. When the other end portion **11***c* is rotated from the open position (B) to the closed position (C), the wound portion **11***a* is unwound, thereby reducing the damping force.

[**0032**] The cylindrical spring member **12** is assembled into the torsion coil spring **11** in a state that the outer diameter thereof is contracted with the slit **13** to accumulate the restoration force. Accordingly, even when the wound portion **11***a* and the cylindrical spring member **12** wear, it is possible to finely adjust torque with the restoration force, thereby maintaining the original damping force for long time.

[**0033**] It is possible to adjust the damping force through adjusting the length and wound diameter of the wound portion **11***a,* the material, length, outer diameter of the cylindrical spring member **12**, and the width of the slit **13**. It is possible to dispose a member **14** for adjusting the damping force such as oil between the wound portion **11***a* and the cylindrical spring member **12**, thereby making it possible to adjust the damping force.

[**0034**] (Opening-Closing Device)

[**0035**] FIGS. **3**, **4**(*a*)-**4**(*b*) and **5**(*a*)-**5**(*b*) are views showing an opening-closing device **23** provided with the spring unit **10** described above. An opening-closing body **21** is rotatably attached to a main body **20** of the device through support shafts **24**. The opening-closing body **21** can be switched toward an open position or a closed position with the urging force of the torsion coil spring **11** of the spring unit **10**. In this embodiment, the opening-closing body **21** can be switched to automatically rotate from the closed position to the open position with the urging force of the torsion coil spring **11**.

[**0036**] The main body **20** has two side surfaces **20***a* including the supporting shafts **24** with a cylindrical shape protruding from the side surfaces **20***a* and spring fixing portions **25** disposed away from the supporting shafts **24**. The supporting shafts **24** have an outer diameter smaller than the inner diameter d of the cylindrical spring member **12**, so that the cylindrical spring member **12** of the spring unit **10** does not interfere with the spring contraction. The supporting shafts **24** have small diameter shafts **26**, and the small diameter shafts **26** have screw holes **27** at tip surfaces thereof. The supporting shafts **24** have a length (not including the small diameter shafts **26**) substantially equal to that of the wound portion **11***a* of the torsion spring coil **11** of the spring unit **10**, or that of the cylindrical spring member **12**.

[**0037**] The opening-closing body **21** is a lid for covering a front surface of the main body **20**, and has arms **22** protruding from an inner side surface thereof at both sides. Each of the arms **22** has a shaft hole **28** at a tip portion thereof. An engagement recess **29** is formed in the opening-closing body **21** corresponding to a latch device **30** formed on the main body **20**. The device latch **30** is supported on a shaft **35**, and has a latch member **31** urged in one direction with a spring member **33** and an operation member **34** for switching the latch member **31** from an engagement position where the latch member **31** engages the engaging recess **29** and an engagement released position.

[**0038**] A process of assembling the opening-closing body **21** to the main body through the opening-closing device **23** will be explained next. The spring unit **10** includes the torsion coil spring **11** having a hooking portion lid formed in an L shape at the other end portion **11***c*. In assembling, the cylindrical spring member **12** integrated with the torsion coil spring **11** corresponds to the supporting shaft **24**, so that the supporting shaft **24** is inserted into the cylindrical spring member **12**, thereby engaging the one end portion **11***b* of the torsion coil spring **11** with a lower portion of the spring fixing portion **25**.

[**0039**] The small diameter shaft **26** of the supporting shaft **24** protruding from the wound portion **11***a* is inserted into the shaft hole **28** of the arm **22**, so that the arm **22** of the opening-closing body **21** is attached to the supporting shaft **24**. At this time, the hooking portion **11***d* of the torsion coil spring **11** engages a lower portion of the arm **22**. In this state, a fixing member such as a bolt **32** is screwed in the screw hole **27** of the small diameter shaft **26** through the shaft hole **28** of the arm **22**, thereby completing the assembly of the opening-closing body **21**.

[**0040**] In the opening-closing device described above, when the opening-closing body **21** is rotated in the clock-

wise direction to the closed position where the torsion coil springs **11** are located at the closed position (C), a claw of the latch member **31** engages the engaging recess **29**, thereby holding the opening-closing body **21** at the closed position. When the opening-closing body **21** is at the closed position, the wound portions **11***a* of the torsion coil springs **11** are unwound, thereby reducing the friction force between the wound portions **11***a* and the cylindrical spring members **12**. The torsion coil springs **11** accumulate the restoration force for always urging the opening-closing body **21** toward the open position (B)

[**0041**] In a state that the opening-closing body **21** is held at the closed position, when the latch device **30** of the operation member **34** is pushed in, the latch member **31** is pushed in the disengaging direction and disengaged from the engaging recess **29**. Accordingly, the opening-closing body **21** is rotated together with the other end portions **10***c* around the small diameter shafts **26** with the restoration force of the torsion coil springs **11** until the other end portions **11***c* move to the open position (B). When the other end portions **11***c* rotate toward the open position (B), the wound portions **11***a* of the torsion coil springs **11** are wound and rotated relative to the cylindrical spring members **12**. In this structure, the friction force between the wound portions **11***a* and the cylindrical spring members **12** becomes the damping force. Accordingly, as the opening-closing body. **21** approaches the open position, the damping force becomes greater, thereby slowing the rotational speed and obtaining smooth rotation. Further, it is possible to prevent the opening-closing body **21** from bouncing.

[**0042**] In the opening-closing device **23** described above, it is possible to obtain the large damping force when the opening-closing body **21** rotates from the closed position to the open position. Alternatively, the damping force may be obtained when the opening-closing body **21** rotates from the open position to the closed position. The opening-closing device is applicable to a rotational switch type assist grip in a vehicle and other holding structures in addition to the box structure.

[**0043**] The disclosure of Japanese Patent Application No. 2004-120069, filed on Apr. 15, 2004, is incorporated in the application.

[**0044**] While the invention has been explained with reference to the specific embodiments of the invention, the explanation is illustrative and the invention is limited only by the appended claims.

What is claimed is:

1. A spring unit with a damper, comprising:

a torsion coil spring having two ends portions, and a wound portion between the two end portions, said wound portion having an inner diameter, and

a cylindrical spring member having a slit extending in a longitudinal direction thereof, and an outer diameter greater than the inner diameter of the wound portion, said cylindrical spring member being disposed in the wound portion in a condition that the cylindrical spring member is radially inwardly compressed.

2. A spring unit according to claim 1, wherein said cylindrical spring member is formed to contract and expand in a radial direction according to movements of the two ends to provide damping force to the ends.

3. A spring unit according to claim 2, further comprising an intermediate material disposed between the wound portion and the cylindrical spring member.

4. A spring unit according to claim 2, wherein said cylindrical spring member has a C-shape cross section.

5. A spring unit according to claim 4, wherein said cylindrical spring member has a lateral length equal to or greater than that of the wound portion.

6. An opening-closing device comprising:

a main body,

an opening-closing body rotationally attached to the main body to move to an open position or a closed position relative to the main body,

a shaft attached to one of the main body and the opening-closing body to rotationally connect the main body and the opening-closing body, and

the spring unit according to claim 1 disposed between the main body and the opening-closing body, one of said two end portions being fixed to the opening-closing body and the other of said two end portions being fixed to the main body.

7. An opening-closing device according to claim 6, wherein said wound portion has the inner diameter at the open position larger than that in an original state of the torsion coil spring, said inner diameter increasing when the opening-closing body rotates to the closed position from the open position in a case that the spring unit urges the opening-closing body toward the open position.

* * * * *